Kent Active System Management
Project Progress Report – December 2017

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1 Executive Summary

1.1 Project Background

The Kent Active System Management (KASM) project started in January 2015 and aimed to carry out a range of technical innovation trials to demonstrate more advanced operations and planning techniques for the 132kV and 33kV network in East Kent, located in the South Eastern Power Networks (SPN) licence area. The project was set up to deliver benefits that span various areas, including the enablement of low carbon generation, the deferral of capital-intensive reinforcement associated with new generation connections and improved reliability of the network.

The last few years have seen several Grid Supply Points (GSPs) come under pressure from the level of generation exporting their power onto the electricity transmission network. The resulting reverse power flows represent an unconventional shift in the way the grid was originally designed to operate. In this new realm, sections of the network are not only supplying their own demand but are also exporting the surplus onto the transmission system several times a year.

The East Kent area used by the project contains four GSPs (of approximately 350 nationwide), and a fifth is being established in the area. It currently requires 34 contingency scenarios to be analysed in order to understand the network fully. The significant uptake of wind and solar generation in recent years, due to government incentives, and the presence of interconnectors connected to the transmission system, increases the number of generation patterns that need to be analysed. There is no longer a simple 'day of highest winter demand' and 'day of lowest summer demand'; there is more variation and hence a greater requirement to monitor all contingencies, and a growth in the number of GSPs affected.

The Contingency Analysis System (CAS) and Forecasting Module (FM) are valuable tools with which to predict the effects of outages on assets (e.g. failures of overhead lines or transformers), allowing engineers to take action to keep the distribution network secure and reliable. Under the KASM project, UK Power Networks has trialled the use of real-time CA and forecasting techniques on Great Britain’s electricity distribution network for the first time. It is also the first trial to use a coordinated data exchange with the electricity transmission network.

The KASM project has demonstrated the value of the CAS and forecasting modules, in operational and planning time frames. The project conservatively estimates the net benefits to be £0.4m in the project trial area. Once proven successful, replication of this method across Great Britain could conservatively provide net benefits of over £62m over the lifetime of the 45-year investment, when compared to business as usual (BAU) approaches.

Total funding for the project is £3.9m, with £3.4m secured from Tier 2 funding under the Low Carbon Networks Fund (LCNF). The remaining funding was provided by UK Power Networks (£450k) and its project partners (£50k).
Over the past three years, the project has successfully achieved key milestones in the form of Successful Delivery Reward Criteria (SDRC). The following SDRC reports are published on UK Power Networks’ Innovation website:

- SDRC 9.1 – Strategy for Inter-Control Centre Communication Protocol (ICCP)
- SDRC 9.2 – Contingency Analysis System Integration
- SDRC 9.3 – Installation of Forecasting Modules
- SDRC 9.4 – Demonstration of use of real-time contingency analysis in the control room

The two remaining SDRCs – 9.5 (Completion of trials and implementation of reliability management, outage management and network capacity management) and 9.6 (Development of business design to incorporate CA as business as usual) – are due to be completed by the end of December. These are covered in more detail below.

1.2 Project Progress

This six-month reporting period, covering June to December 2017, is the sixth and final reporting period for the project, which ends on 31 December 2017. The focus of this reporting period has been on trialling the Contingency Analysis System (CAS) and forecasting modules for the three use cases: reliability management, outage management and network capacity management. During the trial period (May-November 2017) the project successfully demonstrated the benefits of using CA and forecasting capabilities to plan and operate the network more efficiently, which will allow for more distributed generation to export onto the distribution network.

The trials have demonstrated that using forecast load and generation data to model the distribution network can significantly reduce the levels of curtailment applied to generators during periods of planned maintenance. The trials have also demonstrated that additional load and generation can be connected to the network if we move away from worst-case planning assumptions. However, in order to connect large amounts of additional generation or load, these connections will need to be controllable by the DNO. Control can be provided through a number of methods, including active network management schemes. The reliability management trials have proven the benefit of real-time CA and offline study capabilities in the control room. Control engineers have for the first time been able to accurately simulate switching actions in real time, rather than rely on offline studies which are not reflective of actual network conditions. A number of use cases have been demonstrated in the control room environment and feedback from control engineers highlights the significant benefits these capabilities deliver.

The CAS provides short-term analysis capabilities that allow control engineers to reinforce or change their decision on real-time network management.

In addition to trialling the KASM solutions, the project has documented how UK Power Networks plans to incorporate CA and forecasting capabilities as BAU activities. Through a number of stakeholder interviews, the project team gathered feedback which has informed a key part of UK Power Networks’ strategy in transitioning the solutions to BAU.

Successful results were obtained from trialling the software and from creating the business design to incorporate the innovative solutions into BAU. These are clearly demonstrated in this progress report and will be presented in granular detail in our SDRC 9.5 and SDRC 9.6 reports, which will be published at the end of December 2017. For reference, the detailed evidence criteria for these two SDRCs are presented in Table 1 and Table 2 overleaf. These criteria and evidence statements are set out in the Project Direction1 and have remained consistent throughout the project.

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Table 1 – SDRC 9.5 criteria and evidence

<table>
<thead>
<tr>
<th>SDRC 9.5 Criteria</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion of trials and implementation of reliability management, outage management and network capacity management</td>
<td>Published results from functional trials and the achieved benefits in reduced distributed generation curtailment</td>
</tr>
<tr>
<td></td>
<td>Published report demonstrating data collection from Grain, Kemsley, Cleve Hill, Canterbury North, Sellindge, Dungeness and Ninfield 400kV network and sensitivity of the contingency analysis results to this data</td>
</tr>
<tr>
<td></td>
<td>List of connection offers that have been linked to reinforcement when assessed using conventional processes, and identification of those that have been revised to remove the reinforcement requirement after being assessed using the trialled methodology; quantification of the released network capacity based on the comparison of the above list</td>
</tr>
<tr>
<td></td>
<td>Published report on considerations for selecting, designing and installing CA software for each use case</td>
</tr>
</tbody>
</table>

Table 2 – SDRC 9.6 criteria and evidence

<table>
<thead>
<tr>
<th>SDRC 9.6 Criteria</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of business design to incorporate contingency analysis as business-as-usual</td>
<td>• Identification of business areas impacted by the introduction of contingency analysis in a Distribution Network Operator</td>
</tr>
<tr>
<td></td>
<td>• Outline of proposed changes to systems, policies and processes required in the DNO operating model in order to incorporate contingency analysis as part of the business as usual operation</td>
</tr>
</tbody>
</table>

The SDRC 9.5 and SDRC 9.6 reports will be published at the end of December 2017. The project team will publish a close down report in March 2018 and are looking forward to hosting an interactive final learning and dissemination event for stakeholders in April 2018.

1.3 Key Risks

At the time of writing there are no key risks to highlight. A number of previously highlighted risks were resolved during the reporting period; please see Section 8 for more information about these and our risk management process. As the project transitions the KASM solutions developed to BAU, there may be further risks that will need to be considered. These are covered in our SDRC 9.6 report.
1.4 Learning and Dissemination

The project team recognise the importance of ‘best in class’ learning and dissemination and during this reporting period we have rigorously shared learnings from the project with our internal and external stakeholders, as demonstrated below.

The project team presented at several external events during the reporting period, notably the Institution of Engineering and Technology (IET) International Resilience in Transmission and Distribution Networks conference on 26 September 2017, the Low Carbon Networks Innovation Conference on 7 December 2017, and National Grid’s Grid Code Development Forum on 6 September. In all cases the project learnings were well received by a range of attendees, including national and international DNOs, academics, transmission operators, consultants and generators/supply providers. In addition, a number of software demonstration sessions were held to further share the successes of the project, including a demonstration to Northern Ireland Electricity on 29 November 2017. The key messages and learnings presented at each of the learning and dissemination events are described in Section 6.

In November the KASM project was shortlisted for the Energy Institute – Technology Award and for the IET’s Innovation Awards. We are pleased that the significant achievements of the project have been recognised by the industry.

The project team will host a final learning event in April 2018, following publication of the project close down report.
2 Project Manager’s Report

This section describes progress made on the KASM project during the reporting period. The following sections provide an update on each of the workstreams.

2.1 Workstream 1

Workstream 1 is responsible for designing, developing, testing and delivering the Inter-Control Centre Communication Protocol (ICCP) link between UK Power Networks’ and National Grid’s control rooms that allows for the exchange of relevant real-time data for the purpose of state estimation and CA. The ICCP link allows both network operators to understand each other’s network configurations in real time, as well as real-time power flows and voltages on the networks. This additional visibility allows both parties to operate and plan the networks more efficiently and effectively.

No significant milestones were planned by the workstream during the reporting period. The main activity was continued monitoring of the communications link between National Grid and UK Power Networks. We are pleased to advise that the project successfully demonstrated the ICCP link in service in UK Power Networks’ control room. During the period, UK Power Networks’ Information Systems team had a scheduled ICCP Firmware Firewall upgrade plan; the high availability ICCP architecture enabled this upgrade to successfully deploy without any loss of service. The firmware upgrade was performed as a strategic security update by UK Power Networks. Its benefit was to further enhance security on the Front End Processor (FEP) servers used for the ICCP link.

The ICCP will remain live and in service after project closure. The link will be used in UK Power Networks and National Grid’s joint innovation project, Power Potential, which is developing a framework whereby DNOs can provide reactive power services to National Grid. Further information about this project can be found here.

It is important to note that in recent months the ENA’s Open Networks project has recommended ICCP as a method of data exchange between transmission system operators and DNOs. This also aligns with EU code developments instigated by the European Network of Transmission System Operators for Electricity (ENTSO-E), which recommends that real-time data exchanges between DNOs and transmission system operators are mandatory. A consultation is currently under way to receive feedback on these developments. It is important to note that both these recommendations align with the learnings from KASM and will feature in the close down report.

As mentioned in our June 2017 progress report, we plan to roll out the ICCP across our Eastern Power Networks (EPN) and London Power Networks (LPN) licence areas. Although at the time of writing this report no fixed dates have been agreed with National Grid to deliver these works, National Grid has highlighted that the ICCP does align with its objectives. In order to prepare for the roll-out activities, a number of discussions have been held within UK Power Networks and it has been agreed that our Information Systems team will be responsible for rolling out these capabilities following project completion.

“The ICCP link has given us visibility of the National Grid’s network, helped us understand power flows at 400kV and how they affect the power flows at 132kV. This critical piece of information enables us to create more accurate models which help in the way we assess the network.”

UK Power Networks Employee
2.2 Workstream 2

Workstream 2 is responsible for delivering the CAS to satisfy the business requirements of Real Time Mode, Study Mode and Look Ahead Mode.

During the reporting period, the workstream had no major developments planned and therefore concentrated on continuous improvement of the CAS, based on trial participants’ feedback. The agreed defect management process has enabled the workstream to prioritise and track defects/changes to the baseline CAS software released by the supplier. In parallel there was a focus on ensuring that the software hosting infrastructure’s performance, reliability and resilience were sufficiently robust to support the trials. Technical effort was spent setting up the Cloud base VM servers, managing disk space and ensuring that all required data files were delivered accurately and on time.

The Workstream 2 Lead worked with technical support staff in the Information Systems team to manage the software patches and upgrades required during the project trials, as the current software deployment strategy requires manual installation and software upgrades. This was achievable during the trial period due to the relatively low number of trial participants (no more than 10). Moving forward, as the software transitions to BAU the software will need to be deployed in a more automated fashion. Details of the proposed software deployment are highlighted in our SDRC 9.6 report.

Managing change control was a key area of focus for the workstream during the trial period. Due to the CAS relying on data from multiple external applications, it was important to ensure that changes to these ‘feeding’ applications were monitored and controlled. It was also important to understand the impact of upgrading these applications on data outputs used by the CAS. During the reporting period, UK Power Networks scheduled an upgrade of PowerOn (Distribution Management System) software. Prior to the upgrade the Workstream 2 Lead had engaged with GE (the supplier of PowerOn) to understand if it would affect the file exports used by KASM. Although no significant changes were expected, the team encountered a period when the CAS was unable to converge the power flow results. This challenge was quickly resolved once the issue had been identified.

The Workstream 2 Lead worked alongside the Workstream 4 Lead (see Section 2.4) to manage trial participants’ feedback during the trial period. A number of priority defects were resolved. The remaining open defects (see Table 3) are considered to be a lower priority and will be addressed by Bigwood as part of the ongoing maintenance contract that is in place until June 2020.

Table 3 – CAS defects

<table>
<thead>
<tr>
<th>Status of CAS defects</th>
<th>Count of defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raised</td>
<td>119</td>
</tr>
<tr>
<td>Closed</td>
<td>93</td>
</tr>
<tr>
<td>Open</td>
<td>26</td>
</tr>
</tbody>
</table>

The project team trained three control engineers in the use of the tool and provided demonstrations of the software to a wider stakeholder community.

During the trial period the CAS processed 13,329 individual cases and the solution converged 89% of the time. Considering traditional distribution power flow solvers often require manual intervention to demonstrate convergence, this high-level convergence is considered highly successful. Using traditional methods to analyse 13,329 cases it would have required 20 power system engineers to spend six months running all the studies. It also demonstrates the high availability of the software during the trial period.
The Workstream 2 Lead has participated in a number of strategic discussions on the business design for rolling out CA across UK Power Networks’ two other licence areas, EPN and LPN. A key point raised in the discussions was the challenge associated with data mapping used by the KASM project. It was noted that the data mapping rules developed by the project team could not be applied to EPN and LPN due to the legacy naming conventions used in those areas. In order to avoid data mapping challenges across other licence areas, UK Power Networks has agreed to undertake a strategic project to populate all relevant static data required to run a power flow model from data in PowerOn.

Furthermore, a decision has been made to develop the capability to export a network data model from PowerOn in Common Information Model (CIM) format – an industry standard format that can be utilised by several power flow modelling applications. It is anticipated that this capability will be available in Q3 2018 and will be the main data input for the CAS moving forward. It is important to note that this change in data input file will require a modification to the existing CAS application architecture. These enhancements will be progressed outside the project timescales and delivered by UK Power Networks’ Smart Grid Development team, who are responsible for supporting the roll-out of innovation projects in accordance with UK Power Networks’ 2017 Innovation Strategy.

Considering anticipated changes to the application architecture in 2018, and to avoid duplication in testing, it has been decided to delay final User Acceptance Testing (UAT) until these changes have been made. Although formal UAT has not been performed, the project team have conducted a number of surveys with users to capture feedback on the software.

Further detail on the business design to incorporate CA as BAU can be found in our SDRC 9.6 report, which will be published on UK Power Networks’ Innovation website.
2.3 Workstream 3

This workstream is responsible for developing and testing the load and generation forecasting modules that will be used in conjunction with the Look Ahead (LA) mode of the CAS tool and as standalone inputs to existing modelling tools such as DigSilent Powerfactory. The forecasting modules produce an hourly forecast for load, solar and wind generators connected to our 33kV and 132kV networks. The available forecast horizons span from 0-120 hours ahead of real time. The forecasting modules are based on a number of machine learning algorithms that are trained based on data inputs including historical power import/export and historical weather forecasts. Further information about the solution architecture can be found in our SDRC 9.3 report on the project [website](#).

During the reporting period, the Workstream 3 Lead focused on identifying the benefits associated with using load and generation forecasting tools. During the trial period, the project team and system users ran existing business processes associated with outage planning alongside the new KASM processes, to determine the value of using forecasting modules. Unlike the existing business processes, which utilise simplistic worst-case assumptions, the KASM business processes use the output from the load and generation forecasting modules when modelling planned outages. The trials demonstrated that by using these advanced forecasting tools, outage planners can reduce the recommended curtailment of generators.

The benefit of the forecaster is highly dependent on the accuracy it can provide. There are a number of aspects to consider when understanding the accuracy of the forecaster. If the forecaster has high error rates over an extended period of time, the end user will need to apply a high ‘factor of safety’ to account for these errors prior to using the output of the forecast in their modelling tools. From the analysis performed, the accuracy of forecasters can differ significantly between load, solar and wind generation.

The following graphs demonstrate the range in accuracy that has been achieved over the trial period. Figure 1 shows a comparison of observed power (the x-axis) against the difference between observed and forecast/predicted power output (the y-axis). The graph demonstrates a low error rate across the range of observed powers. The data points above the red dotted line indicate when the forecaster has underpredicted the output of the generator and the data points below the red dotted line indicate when the forecaster has overpredicted the output of the generator. In the context of outage management, it is important to avoid the forecaster underpredicting the output of the generator. This is because an underprediction will result in more power being exported onto the network than that accounted for by the outage planning manager.
Figure 1 – Errors in forecast outputs for a specific wind generator (high accuracy)

- **Underprediction**
- **Overprediction**
Figure 2 shows errors in the forecast outputs for another wind generator in the trial area, which has significantly lower levels of accuracy. It can be noted that in a number of cases, when the observed power was zero, the forecaster predicted high power exports from the generator. It is presumed that this is due to the generator taking an outage of plant which has not been taken into account by the forecaster. This behaviour will exist in the training data sets used to train the machine learning algorithms and can be a cause of reducing levels of accuracy. Going forward, the team will continue to investigate solutions for improving the accuracy of sites that produce high levels of error. Figure 1 demonstrates that by using historical forecast weather data and historical outputs from generators, machine learning algorithms can be trained to accurately forecast generation output. The following section provides additional reasons for inaccurate forecasts.

When analysing outputs from solar sites, similar behaviours can be observed.
There are a number of reasons for poor quality forecasts, including:

- Poor quality training data for the forecaster – for example, missing data due to SCADA communication issues, or inaccurate data due to monitoring equipment drifting from original calibration points
- Poor choice of algorithms to model the forecast behaviours
- Insufficient training data to accurately capture behaviours across seasons
- Changing behaviours of the generators – capturing generator outage data during the training period will ensure the forecast aligns with physical capabilities on site
- Inaccuracies in weather forecasts due to the unavailability of relevant forecast weather data

During the trial period, the Workstream 3 Lead worked alongside the Workstream 4 Lead to manage trial participants’ feedback. A number of priority defects were resolved. The remaining open defects (see Table 4) are considered to be a lower priority and will be addressed by Bigwood as part of the ongoing maintenance contract that is in place until June 2020.

Table 4 – FM defects

<table>
<thead>
<tr>
<th>Status of forecaster module defects</th>
<th>Count of defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raised</td>
<td>38</td>
</tr>
<tr>
<td>Closed</td>
<td>34</td>
</tr>
<tr>
<td>Open</td>
<td>4</td>
</tr>
</tbody>
</table>

During the reporting period, the Workstream 3 Lead worked with the project team to identify the business design for rolling out the forecasting modules to BAU. A number of key recommendations were compiled during these discussions. Considering the existing architecture of the forecaster, which is dependent on data from the CAS to operate, it has been decided that decoupling the forecaster and the CAS will allow for a more agile BAU deployment strategy. The proposal would be for the forecasting module to interface directly with UK Power Networks’ PI data historian. This requires a relatively small change to the forecasting module which will be delivered outside the scope of the project as part of the BAU transition.

Key learnings developed throughout the project will feed into UK Power Networks and National Grid’s innovation project, Power Potential. This project is developing a solution which can forecast day-ahead and intra-day availability of generation and demand including MVAr/MW. Although the detailed requirements for the Power Potential forecast are different and an alternative forecaster is being used, there remain key learnings which can be shared. These learnings will provide a foundation of knowledge to build on when developing the forecasters for Power Potential. Where there are similarities in forecast time horizons and generator types, the KASM forecast can be used as a benchmark for accuracy. This benchmark will be extremely valuable when testing the Power Potential forecasters. The key learnings associated with the accuracy of training data have been raised with UK Power Networks’ Power Potential project team, who are exploring opportunities to improve training data based on a number of assumptions.
2.4 Workstream 4

Workstream 4 is responsible for understanding the value streams and business process impacts of the CAS and forecasting modules. In order to understand the value streams developed, the project team trialled a number of use cases across three key user groups. These user groups include:

1. Network control engineers – responsible for managing reliability of the network in real time (Reliability Management trials)
2. Outage planning engineers – responsible for managing planned network outages (Outage Management trials)
3. Infrastructure planning engineers – responsible for assessing new load and generation connection requests and strategic reinforcement of the network (Capacity Management trials)

During the trial period, the Workstream 4 Lead worked closely with the trial participants to capture the benefits of each solution. The key solutions used as part of the KASM trial were:

1. The real-time data exchange link (ICCP link) with National Grid
2. Short-term load and generation forecasting modules
3. State estimation and CA tools

The Workstream 4 Lead also worked alongside the trial participants to demonstrate the value of the solutions described above. The following sections describe the objective and high-level outcomes from the trials.
2.4.1 Outcome from Reliability Management Trials

The objective of the Reliability Management trials was to determine the benefits of using state estimation and CA in the control room. State estimation capabilities enable control engineers to build a full understanding of power flows on the network rather than just have visibility of where monitoring equipment is installed. CA allows control engineers to understand the power flows on the network under specific N-1 scenarios, which may be representative of the next fault on the network. The CAS also allows control engineers to simulate the closing or opening of a switch and the impact of performing this action on the network power flows. As significantly more distributed generation connects to the network it becomes increasingly difficult to predict power flows under varying network configurations without the use of advanced CA software.

The full benefits from the Reliability Management trials are presented in our SDRC 9.5 report, which will be published on UK Power Networks’ Innovation website.

The following statement captures feedback from a control engineer trial participant who used the tool during the trial period.

“The KASM can assist with predicting likelihood of capacity breaches in upcoming hours without the need to resort to offline system study or desk-top calculation. The ICCP link and Forecaster improve the accuracy of the prediction by removing the need for estimation.”

UK Power Networks Employee

Figure 4 shows one of the trial participants using the KASM solutions in UK Power Networks' control room.
2.4.2 Outcome from Outage Management Trials

The objective of the Outage Management trials was to determine the benefit of using forecast load and generation data instead of worst-case assumptions when modelling planned outages. Worst-case assumptions are based on maximum generation export and minimum demand. Due to the significant amounts of distributed generation on the network, using these assumptions can create scenarios where certain assets reach their reverse power flow limits. As a preventative measure, an outage planner will curtail certain generators to reduce the risk of reverse power flow overloads or voltage violations on the network which have the potential to damage existing assets.

During the trial period, the Workstream 4 Lead focused on understanding how the output of the forecasters could be optimised when modelling planned network outages. The forecaster data is available at 120 hours ahead of real time – so can be used by outage planners at this point to model outages based on this data, rather than worst-case assumptions. The comparison between the existing process and the KASM trial process is shown in Table 5.

Table 5 – High-level processes compared during the Outage Management trials

<table>
<thead>
<tr>
<th>2 weeks ahead of outage</th>
<th>1 week ahead of outage</th>
<th>5 days ahead of outage</th>
<th>24 hours ahead of outage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Process</strong></td>
<td>Plan outage based on 2 week ahead National Grid System Studies data (minimum demand and maximum generation)</td>
<td>Plan outage based on transmission generation updates; decide on curtailment</td>
<td>No update</td>
</tr>
<tr>
<td><strong>KASM Trial Process</strong></td>
<td>Plan outage based on 2 week ahead National Grid System Studies data (minimum demand and maximum generation)</td>
<td>Plan outage based on transmission generation updates</td>
<td>Plan outage based on 5 day ahead forecast data, plan curtailment</td>
</tr>
</tbody>
</table>

“The CAS solution is providing the building blocks for UK Power Networks to move forward to operating a more dynamic system as a DSO. With accurate data provided by the Forecaster we are able to operate our network in a more pragmatic way rather than always just considering worst case which will lead to lower levels of constraints to DG customers connected to the network. Without this form of funding from Ofgem DNOs would not be able to trial innovative solutions as the chance of not delivering on the requirements would mean DNOs rely on proven methods leading to stagnation in the industry.”

UK Power Networks Employee

When comparing the results from implementing the KASM trial process and the existing process, the project has demonstrated that significant reductions in applied curtailment can be achieved. The full benefits from the Outage Management trials are presented in our SDRC 9.5 report, which will be published on UK Power Networks’ Innovation website.
2.4.3 Outcome from Capacity Management Trials

The objective of the Capacity Management trials was to demonstrate the benefits of building an archive of real-time contingency scenarios. It is anticipated that this additional visibility will help infrastructure planners move away from certain worst-case assumptions they use when planning for new network connections. In addition, it will help planners understand which network contingencies result in significant network violations. This will ensure that credible worst-case contingencies are analysed when modelling new connections, rather than expected worst-case contingencies.

During the trial period, the Workstream 4 Lead worked alongside the infrastructure planners to determine the benefits of historical data collected during the KASM trials. The infrastructure planners assessed the benefits using realistic future connection requests, as no further connection requests were applied for by customers during the trial period. These connections could be considered expansions of existing generation sites. When analysing these connections requests based on updated information available from the KASM trials, the infrastructure planners identified that additional capacity was available.

Using historical data available from the KASM trials without any ‘smart’ control, a limited amount of additional load and generation capacity can be accommodated. When using the KASM solutions alongside ‘smart’ solutions (e.g. active network management) to control load or generation, significant amounts of generation can be connected.

“The CA was a very useful tool that we used to identify the most onerous N-1 and N-2 scenarios to be used when assessing Flexible DG connections in the Canterbury/Sellindge area.”

UK Power Networks Employee

During the reporting period a number of strategic projects were undertaken in the South Coast region of SPN. Over the past few months UK Power Networks has opened the KASM area for Flexible Distributed Generation connections, allowing generators to connect in traditionally constrained areas of the network under a flexible connection. A flexible connection allows the DNO to manage the export of generation in real time to mitigate against any potential violations which may occur due to large amounts of distributed generation exporting at the same time. Furthermore, the region has been impacted by a project called the Regional Development Programme, which is a collaborative initiative between UK Power Networks and National Grid. This initiative started in August 2016 and aims to develop a collaborative, joined-up approach to connecting additional generation in the South Coast network area.

The full benefits from the Capacity Management trials are presented in our SDRC 9.5 report, which will be published on UK Power Networks’ Innovation website by the end of December 2017.

2.4.4 Additional Considerations

The Workstream 4 Lead has continued to engage with National Grid to build on existing real-time data exchange capabilities. As described in our June 2017 progress report, National Grid is unable to share certain power flow data with UK Power Networks due to the data items being considered as third party data. The issue has been investigated and the Workstream 4 Lead has been working with a number of generating companies to gain consent for National Grid to share this data over the existing ICCP link. Following discussions with a number of generating companies, they have highlighted concerns over the impact of the REMIT regulations on sharing the data. (These are EU regulations on energy market integrity and transparency.) In order to understand the issue in more detail, one of the generating companies has approached Ofgem for clarification on this matter, through email correspondence. Resolving this concern will allow for more accurate modelling within the CAS and will also allow for better coordination of future smart grid initiatives, which require closer synchronisation between transmission operators and DNOs.
The Workstream 4 Lead presented the challenges at the Grid Code Development Forum on 6 September. The audience understood these challenges and agreed in principle that the exchange of data would allow for better operation and planning of the distribution networks. The Workstream 4 Lead has supported a Grid Code Modification Proposal, which will be presented to the Grid Code Panel in January 2018. The proposal highlights the challenges the KASM project has encountered when using existing transmission data and requests that further data is exchanged between National Grid and UK Power Networks for the purpose of operating and planning the network. Among other data items, it includes real-time power flows on interconnectors and real-time power flows associated with transmission connected generators. The proposed data exchange provides benefits not only for the KASM solutions but also for UK Power Networks and National Grid’s joint project, Power Potential.
2.5 Technical Design Authority

The Technical Design Authority (TDA) is responsible for all aspects of commercial, functional and technical design and architecture. It is charged with the review and approval of the commercial, functional and technical requirements specifications and architecture for the project, and for ensuring the end-to-end technical design enables the project to deliver to the objectives outlined in the KASM proposal. Moreover, it ensures that the design is consistent with architectural principles and is capable of being adopted as the reference architecture which can then be integrated into the wider organisation to deliver organisational benefits.

The TDA is made up of five key roles: Technical Lead, IT Solution Architect, Network Control, Outage Planning and Infrastructure Planning. The TDA also includes an external industry consultant, to ensure accurate scope definition.

During the trial period, the TDA supported the trial participants and Workstream 4 Lead in demonstrating the value streams and business process impacts. Key activities included:

- Supporting the delivery of technical training to trial participants
- Supporting the Workstream 4 Lead in developing frameworks to track the benefits of the solutions
- Providing support during the prioritisation of defect management
- Providing support during defect resolution

Figure 5 presents the key stakeholders impacted by the business design to incorporate the KASM solutions into BAU.

As well as supporting the trials, the TDA supported the development of the business design to incorporate the CAS and the forecasting modules into BAU. The TDA conducted a number of workshops with internal and external stakeholders to identify the areas of the business impacted by the roll-out of CA to a BAU application.

**Figure 5 – Stakeholder impact map**

- **Asset Management**
- **Information Systems**
- **Network Operations**

**UK Power Networks**

| ARB – Architecture Review Board | BSI – Bigwood Systems Inc. |
| CSI – Control Systems Infrastructure | GC – Generation Customer |
| CSA – Control Systems and Automation | NG – National Grid |
| OP – Outage Planning | SGD – Smart Grid Development |
| CE – Control Engineer | OP |
| IP – Infrastructure Planning | CSI |
| CE |
| SGD |

---

As the project transitions to BAU any future technical design considerations will be made by the key business users of the system, as noted in Figure 5. If significant changes to architecture are required, these will be approved in accordance with UK Power Networks’ Architecture Review Board.

Our SDRC 9.6 report provides further information about the changes to systems, policies and processes required in a DNO operating model to incorporate CA into BAU. This will be published on UK Power Networks’ Innovation website.
3 Business Case Update

The business case remains consistent with our June 2017 progress report. Based on regular engagement with the potential users of the KASM solution, there remains a strong case for implementing the CAS and forecasting modules.

A full review of the business case will be presented in the project close down report, due in March 2018.

4 Progress against Budget

This section is provided as a confidential appendix – see Appendix A.
5 Successful Delivery Reward Criteria (SDRC)

The following table describes the six SDRCs which have been agreed with Ofgem in the Project Direction for the KASM project. It also provides a description of progress made against each SDRC.

<table>
<thead>
<tr>
<th>SDRC</th>
<th>Progress</th>
<th>Scheduled Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1</td>
<td><strong>Criterion</strong>&lt;br&gt;Development of the strategy for inter-control room communication protocol for the purposes of KASM.&lt;br&gt;&lt;br&gt;<strong>Evidence</strong>&lt;br&gt;- Published report on key technical and commercial challenges relevant to inter-control room link and the KASM project, whether proposed by the KASM team or raised by stakeholders, including other DNOs;&lt;br&gt;- Implementation guidelines for the inter-control room communication link in consultation with National Grid for use by the project.&lt;br&gt;• SDRC completed and submitted on 29 December 2015. The learning report is available on UK Power Networks’ Innovation website.&lt;br&gt;• The report highlights the key technical and commercial challenges linked to business architecture, data architecture, technical architecture, security architecture and operational management. It describes the solution objectives and incorporates feedback from other DNOs and considers regulatory obligations (see Section 3).&lt;br&gt;• The report details the logical architecture which UK Power Networks has implemented, which forms a foundation for guidelines to other DNOs.</td>
<td>December 2015</td>
</tr>
</tbody>
</table>

https://www.ofgem.gov.uk/sites/default/files/docs/2015/01/project_direction_kasm.pdf
<table>
<thead>
<tr>
<th>SDRC</th>
<th>Progress</th>
<th>Scheduled Date</th>
</tr>
</thead>
</table>
| 9.2  | **Criterion**  
Completion of the system integration of CA software into UK Power Networks systems, excluding a real-time link to National Grid. | **Evidence**  
- Sign-off on set up of CA software;  
- Sign-off on successful demonstration and testing of CA software; and  
- Published report on CA software integration that includes the control room IT architecture, lessons learned, engagement with other DNOs, and identified risks. | SDRC completed and submitted on 30 November 2016. The learning report is available on UK Power Networks’ Innovation website.  
Section 6 of the report provides sign-off on the set up of the CA software from UK Power Networks’ Architecture Review Board.  
Section 7 of the report demonstrates successful installation and testing of the CA software.  
Section 5 of the report describes the control room IT architecture required to incorporate CA software. It describes the business architecture, data architecture, application architecture, technology architecture and security architecture that UK Power Networks has implemented.  
Section 8 of the report describes our engagement with other DNOs through a variety of forums.  
Section 9 of the report highlights the lessons learned through the design, installation and testing of CA software. It also describes the key risks that other DNOs need to consider when implementing similar projects to introduce real-time CA software. | November 2016 |
<table>
<thead>
<tr>
<th>SDRC</th>
<th>Progress</th>
<th>Scheduled Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3</td>
<td>Criterion</td>
<td>SDRC completed and submitted on 30 November 2016. The learning report is available on UK Power Networks' Innovation website.</td>
</tr>
<tr>
<td></td>
<td>Completion of installation of forecasting modules that will link the DNO control room with other data sources.</td>
<td>Section 6 of the report provides sign-off on the set up of the CA software from UK Power Networks’ Architecture Review Board.</td>
</tr>
<tr>
<td></td>
<td>Evidence</td>
<td>Section 7 of the report shows the forecast data compared with historical data for the purpose of benchmarking. It demonstrates forecasts for solar, on-shore wind and off-shore wind generators. It also demonstrates the impact of aggregating forecasts across primary substations, 132kV circuits and at GSP levels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Section 5 of the report describes the integration architecture. It considers business architecture, data architecture, application architecture, technology architecture and security architecture.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Section 9 of the report describes the lessons learned and risks that other DNOs should consider when designing, installing and testing similar forecasting modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>November 2016</td>
</tr>
</tbody>
</table>

- Sign-off on installation of forecasting modules;
- Forecast data, benchmarked for accuracy against historical data;
- Published report demonstrating forecasts including each of solar, on-shore wind and off-shore wind;
- Forecast error curves plotted at primary substation, 132kV circuit, and GSP levels;
- Description of integration architecture with the overall solution; and
- Published report on data aggregating forecasting modules that includes lessons learned and identified risks.
<table>
<thead>
<tr>
<th>SDRC</th>
<th>Progress</th>
<th>Scheduled Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.4</td>
<td><strong>Criterion</strong>&lt;br&gt;Demonstration of use of real-time CA in the control room.</td>
<td>• SDRC completed and submitted on 14 June 2017. The learning report is available on UK Power Networks’ Innovation <a href="#">website</a>.&lt;br&gt;• Section 5 of the SDRC report demonstrates the use of live SCADA readings in the CA tool within the 15-minute criteria.&lt;br&gt;• Section 6 of the SDRC report describes feedback from control room engineers following a user survey. It highlights the most critical forecast time period as being the next shift, which is considered 12 hours ahead of time.&lt;br&gt;• Section 4 of the report describes the solution capabilities and user interface that have been developed.</td>
</tr>
<tr>
<td></td>
<td><strong>Evidence</strong>&lt;br&gt;• Demonstration of contingency results from live SCADA readings, supplied within 15 minutes of them being collected;&lt;br&gt;• Completion of user survey identifying the most critical forecast time periods perceived by control room users (e.g. next 15 mins; tomorrow; next shift); and&lt;br&gt;• Published report with description of the solution, the user interface, and the capabilities.</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td><strong>Criterion</strong>&lt;br&gt;Completion of trials and implementation of reliability management, outage management and network capacity management.</td>
<td>• This SDRC remains on track for delivery by the end of December 2017.&lt;br&gt;• Key evidence criteria have been collected for each of the trial use cases (reliability management, outage management and capacity management).&lt;br&gt;• Trial participants have agreed the benefits of the KASM solutions.&lt;br&gt;• Data has been collected from the key 400kV substations.&lt;br&gt;• Internal stakeholders have been engaged to determine key considerations for selecting, designing and installing CA for each use case.</td>
</tr>
<tr>
<td></td>
<td><strong>Evidence</strong>&lt;br&gt;• Published results from functional trials and the achieved benefits in reduced DG curtailment;&lt;br&gt;• Published report demonstrating data collection from Grain, Kemsley, Cleve Hill, Canterbury North, Sellindge, Dungeness and Ninfield 400kV network and sensitivity of the CA results to this data;&lt;br&gt;• List of connection offers that have been linked to reinforcement when assessed using conventional processes, and identification of those that have been revised to remove the reinforcement requirement after being assessed using the trialled methodology; quantification of the released network capacity based on the comparison of the above list; and&lt;br&gt;• Published report on considerations for selecting, designing and installing CA software for each use case.</td>
<td></td>
</tr>
<tr>
<td>SDRC</td>
<td>Progress</td>
<td>Scheduled Date</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>----------------</td>
</tr>
<tr>
<td>9.6</td>
<td><strong>Criterion</strong>&lt;br&gt;Development of business design to incorporate CA as business-as-usual.</td>
<td>- The SDRC is on track for delivery by the end of December 2017.&lt;br&gt;- Workshops have been hosted with key business areas impacted by the introduction of CA tools.&lt;br&gt;- The changes to business process, systems, policies and key stakeholders are described in the report.</td>
</tr>
<tr>
<td></td>
<td><strong>Evidence</strong>&lt;br&gt;• Identification of business areas impacted by the introduction of CA in a Distribution Network Operator; and&lt;br&gt;• Outline of proposed changes to systems, policies and processes required in the DNO operating model in order to incorporate CA as part of the business as usual operation.</td>
<td></td>
</tr>
</tbody>
</table>

6  Learning Outcomes and Knowledge Dissemination

6.1  Learning Outcomes

During the reporting period, the project team continued to test and trial a number of solutions developed as part of the KASM project. Throughout this process we captured a number of learnings which will be valuable to the DNO community.

Key learning outcomes during this period were:

1) Complex data mapping solutions are not easily scalable across licence areas, where legacy naming conventions may differ from one licence area to another. A single data model is suggested as a starting point for contingency analysis;

2) Real-time state estimation can be performed on distribution networks with a high level of converging cases; however, to reduce differences in estimated states and measurements states, network operators need to focus on improving real-time data quality;

3) Visibility of transmission data is useful to understand the configuration transmission network, however increasing the number of data points exchanged will help improve whole system state estimation;

4) The accuracy of forecasters is highly dependent on training data; therefore data cleansing rules are fundamental prior to training any forecaster with machine learning algorithms. For example, understanding when generators have taken outages will help with tuning of the algorithms;

5) Providing visibility of historical network conditions can improve network planning processes, however ‘smart’ solutions will always be required if network planners move away from worst-case assumptions; and

6) When developing new innovative solutions it should be remembered that certain modules may be simpler to roll out and may deliver benefits more easily, whereas others have more complexity. This should be taken into account when designing the solution. It is important not to place too much reliance on newly developed solutions, which cannot immediately be scaled.

6.2  Internal Communications and Knowledge Dissemination

The project team have continued to engage with key stakeholders within UK Power Networks. Key users of the tools include control engineers, outage planners and infrastructure planners.

As part of our work for SDRC 9.6, we hosted a number of meetings across our business to disseminate learning from the project and gather insights to inform our BAU deployment strategy. This included meetings with our teams in Information Systems, Asset Management and Network Operations. These sessions involved engagement from other licence areas outside the Innovation trial area used for KASM. In addition, a number of software demonstration sessions have been held with non-trial participants.

The project team hosted a demonstration session with Bigwood Systems on 4 December 2017 for a range of stakeholders who had not participated in the trials. This session helped gain further feedback and ensure continuous improvement of the existing solution.

As mentioned in our June 2017 progress report, the project continues to share learnings from KASM with the TDI 2.0 project. The focus of these learnings to date has been on understanding what factors affect load and generation forecast accuracy and highlighting data issues that will improve state estimation results.
6.3 External Communications and Knowledge Dissemination

During the reporting period, the project team presented at a wide range of dissemination events with a broad range of attendees. The key presentations are listed in Table 7. In addition, the project was shortlisted for two industry leading awards, as shown in Table 6. This industry recognition shows the quality and contributions the KASM project has delivered over the past three years.

Table 6 – Awards for which KASM was shortlisted during the reporting period

<table>
<thead>
<tr>
<th>Award</th>
<th>Category</th>
<th>Status</th>
<th>Ceremony date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Institute Awards</td>
<td>Technology</td>
<td>Shortlisted</td>
<td>9 November 2017</td>
</tr>
<tr>
<td>IET Innovation Awards</td>
<td>Power</td>
<td>Highly Commended</td>
<td>15 November 2017</td>
</tr>
</tbody>
</table>

The two core dissemination activities were the Low Carbon Networks Innovation conference in Telford and the IET’s International Resilience in Transmission and Distribution Networks conference in Birmingham. In April 2018 the project team will host a close down event which will disseminate learnings from the entire project. It was decided that this would be a more appropriate time to disseminate knowledge considering the LCNI conference is in December.

The project team presented the project objectives and results from trials during a technical session on 7 December 2017. In addition, the project team engaged with a number of stakeholders at the UK Power Networks Innovation stand. A number of demonstrations of software were provided to interested parties. The project team created an interactive video, which was displayed at the conference. The video summarises the challenges and achievements of the project in a highly engaging manner and will be published on UK Power Networks’ Innovation website.
The project team worked with a PhD student at Imperial College London to submit a paper for the IET’s international conference on Resilience in Transmission and Distribution Networks (RTDN). The paper, titled ‘Enhancing distribution network visibility using contingency analysis tools’, was invited for formal presentation at the conference. The paper highlighted the challenges and benefits of performing real-time power flow calculations for the purpose of improving network visibility. Key challenges described in the paper included: building a real-time model from a single source, visibility of whole networks, data availability, and quality of real-time measurement data. Figure 6 shows a member of the project team presenting the paper at the RTDN conference in Birmingham.

During the Q&A session a member of the audience asked if UK Power Networks will use the state estimation results to drive a data quality improvement plan. It was highlighted that where state estimation results have high errors between measured values and calculated values, this can be due to poor quality measurement data. The project team highlighted that this was an opportunity that would be discussed with UK Power Networks’ Asset Management and Network Operations departments, but had not been agreed to date.

![Figure 6 – A member of the project team presenting at the RTDN conference in Birmingham](image-url)
### Table 7 – Conferences and formal dissemination events attended

<table>
<thead>
<tr>
<th>Conferences and formal dissemination activities</th>
<th>Key messages/presentation title</th>
<th>Audience</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK Power Networks Losses Conference (London)</td>
<td>Title: KASM – Network losses</td>
<td>DNOs, suppliers and academics</td>
<td>6 July 2017</td>
</tr>
<tr>
<td></td>
<td>Key messages:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Introduction to KASM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The KASM tools can provide the foundation for performing losses calculations on the network. The additional losses tool developed for the Losses Discretionary Reward can provide an understanding of losses across the whole system under a significant number of network configurations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK Power Networks Distributed Energy Resources Connections Forum (London)</td>
<td>Title: Kent Active System Management Overview</td>
<td>DER owners and developers</td>
<td>18 July 2017</td>
</tr>
<tr>
<td></td>
<td>Key messages:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Introduction to KASM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• How will the new tools and processes affect existing customers? Outage planners will use advanced analytics tools to inform customers of the levels of curtailment closer to real-time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid Code Development Forum (Warwick)</td>
<td>Title: Real-time data exchange with DNOs</td>
<td>DNOs and transmission operators</td>
<td>6 September 2017</td>
</tr>
<tr>
<td></td>
<td>Key messages:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In order for DNOs to model the whole system accurately in real time, they require the real-time power injection at transmission connected generators and interconnectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Attendees of the forum were in general in agreement with the principles, but no clear indication of how to update regulation to accommodate this data exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conferences and formal dissemination activities</td>
<td>Key messages/presentation title</td>
<td>Audience</td>
<td>Date</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------------</td>
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</tr>
</tbody>
</table>
| IET’s International Resilience in Transmission and Distribution Networks Conference Paper and Presentation Submission (Birmingham) | **Title:** Enhancing distribution network visibility using contingency analysis tools  
**Key messages:**  
- KASM provides an innovative solution that enhances network visibility  
- As the levels of SCADA increase on distribution networks, so will the level of accuracy of power flows solvers  
- As power flows become more volatile due to intermittent generation, it is important that the behaviour of network assets is accurately modelled to better secure efficient operation of the networks | Academics, international DNOs, transmission operators, consultants and suppliers | 26 September 2017 |
| KASM software demonstration | **Title:** Demonstration of KASM solutions  
**Key messages:**  
- Introduction to KASM  
- Software demonstration sessions including CAS and FM  
- Data challenges – discussion | Northern Ireland Electricity | 29 November 2017 |
| Low Carbon Networks Innovation Conference (Telford) | **Title:** Kent Active System Management  
**Key messages:**  
- Introduction to Kent Active System Management  
- Key solutions developed during the project  
- Benefits proven during the trial period  
- Key considerations for rolling out contingency analysis and forecasting to BAU  
- Lessons learned throughout the project | Academics, international DNOs, transmission operators, consultants and suppliers | 6-7 December 2017 |
6.4 Learning and Dissemination Activities planned in 2018

The project team will host an interactive close down event in April 2018 where a range of stakeholders, including other DNOs, will be invited to share the learnings from the entire project. It is anticipated that this event will be hosted in London. It was decided that a close down event in Q1 2018 would be more suitable and attract more attention than hosting an event during the same period as the LCNI in Telford.

This dissemination event is a valuable opportunity for other DNOs who are planning to implement similar tools to understand key risks and lessons learned during the three years of the project. In addition, it will highlight the benefits that the KASM solutions can deliver to DNOs and customers. KASM has highlighted a number of opportunities where DNOs can deliver smart savings.

Close down events organised by UK Power Networks for previous LNCF projects have received excellent feedback. Lessons learned from organising these events will be accounted for when planning the KASM event.

The project team will also produce a close down report to complement the close down event. This will be published in March 2018.

<table>
<thead>
<tr>
<th>Conferences and formal dissemination activities</th>
<th>Key messages</th>
<th>Date</th>
</tr>
</thead>
</table>
| KASM close down event (London)                | • Introduction to project  
• Lessons learned from developing the tools  
• Benefits demonstrated during trial period  
• UK Power Networks’ business as usual transition strategy | April 2018 |
## Intellectual Property Rights (IPR)

During the period the following IPR (foreground or relevant foreground) was generated (June-December 2017):

<table>
<thead>
<tr>
<th>Workstream</th>
<th>IPR description</th>
<th>IPR Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS4</td>
<td>KASM SDRC 9.5 report</td>
<td>UK Power Networks</td>
</tr>
<tr>
<td>WS4</td>
<td>KASM SDRC 9.6 report</td>
<td>UK Power Networks</td>
</tr>
</tbody>
</table>
8 Risk Management

The KASM project has established a risk management process as described in detail in the KASM Project Handbook submitted with our June 2015 progress report. It allows for the communication and escalation of key risks and issues within the project and defines where decisions are made and how these will be communicated back to the workstream of risk origin. Risks are reviewed on a weekly basis and are currently documented on a monthly basis at Progress Reporting Meetings. Key project risks are escalated to the Project Steering Committee for review and approval of the mitigation on a monthly basis. During the reporting period, UK Power Networks’ Innovation team developed a new Innovation delivery procedure, SR 07 005, which details the Innovation governance processes. It captures the full innovation lifecycle, from capturing innovation ideas to realising the benefits that innovation projects deliver. This new process supersedes the processes described in the KASM Project Handbook. The Innovation procedure SR 07 005 is available upon request.

8.1 Bid Risks managed this Period

The following table displays the risks identified in our previous six-month progress report (June 2017) and provides a mitigation update. There are three risks which remain open, but these are considered to be low and the mitigation actions will be handed over to the relevant teams managing the solution in future years.

<table>
<thead>
<tr>
<th>Ref BID#</th>
<th>WS</th>
<th>Risk &amp; Impact Description</th>
<th>BID Mitigation</th>
<th>Mitigation (update)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>B003</td>
<td>WS1</td>
<td>The software solution fails to perform to specification, leading to system incompatibilities and unsatisfactory trial results.</td>
<td>The software solution will be subject to performance testing using benchmarking or simulators under various operating conditions. Software requirements to be defined at design stage and suitable software chosen for the purpose of the trials. UK Power Networks to agree Service Level Agreements (SLAs) for software solution.</td>
<td>Requirements and design phases involve all parties (suppliers and business users) to ensure that the software solutions meet the performance requirements. Clear test strategies have been implemented to check performance. Software performed in line with expectations during the trial period.</td>
<td>Closed</td>
</tr>
<tr>
<td>Ref BID#</td>
<td>WS</td>
<td>Risk &amp; Impact Description</td>
<td>BID Mitigation</td>
<td>Mitigation (update)</td>
<td>Status</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td>B0004</td>
<td>WS5</td>
<td>There is lost learning during knowledge dissemination and stakeholder engagement activities due to differing interests and learning styles of stakeholders.</td>
<td>Identify stakeholders early on. The dissemination workstream is fully engaged with the technical workstream at an early stage and lessons learned are captured from the LCNF projects.</td>
<td>Early engagement with all key stakeholders has taken place and will continue to ensure positive support of the project. Successful learning and dissemination events have been held and will continue to be a focus area. A final learning event will take place in April 2018.</td>
<td>Open</td>
</tr>
<tr>
<td>B0006</td>
<td>PM</td>
<td>The software partner goes out of business before the solution is delivered.</td>
<td>Full financial due diligence undertaken as part of UK Power Networks’ procurement procedure; identify alternative supplier.</td>
<td>Full diligence has been undertaken and an alternative supplier has been selected. The software partner has delivered the software solution that has delivered the required outcomes of the trials.</td>
<td>Closed</td>
</tr>
<tr>
<td>B0007</td>
<td>PM</td>
<td>The software partner goes out of business after the solution has been delivered, resulting in lack of continuity/support.</td>
<td>Full financial due diligence undertaken as part of UK Power Networks’ procurement procedure; arrange a software ESCROW (third party agent who stores source code) and novation of liabilities to Original Equipment Manufacturers (OEM).</td>
<td>The solution has now been delivered. Ongoing management of the supplier will be maintained outside the project team.</td>
<td>Open</td>
</tr>
<tr>
<td>B0008</td>
<td>WS4</td>
<td>The trials do not deliver the expected results.</td>
<td>Expectations are managed due to thorough planning and frequent reporting. Lessons gathered throughout process.</td>
<td>The project has delivered key learning outcomes from the trial period and the benefits are clearly articulated in the SDRC 9.5 report.</td>
<td>Closed</td>
</tr>
<tr>
<td>Ref BID#</td>
<td>WS</td>
<td>Risk &amp; Impact Description</td>
<td>BID Mitigation</td>
<td>Mitigation (update)</td>
<td>Status</td>
</tr>
<tr>
<td>---------</td>
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<td>------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>B0013</td>
<td>WS2</td>
<td>Visualisation of outputs from software tool not in line with operator expectations.</td>
<td>Engage with operators early in the process to help inform the design, to mimic existing Distribution Management System. Limited contingency added into timescales to allow redesign if necessary.</td>
<td>Users have provided positive feedback on the tool. The solution continues to take on feedback from users as it transitions to BAU. The additional changes to visualisation will be managed under change requests and will form part of the continuous improvement of the software.</td>
<td>Closed</td>
</tr>
<tr>
<td>B0014</td>
<td>PM</td>
<td>Connectees commit to pay for significant SGT upgrades at both Canterbury and Richborough and overhead line upgrades, adding significant capacity to the network and removing the export constraints.</td>
<td>Monitor all new connection requests. Support any efforts by distributed generation developers to form group connections or joint connection requests.</td>
<td>No generation customers have indicated that they will contribute to installing a third SGT at Richborough; however, this cannot be guaranteed outside the project timescales.</td>
<td>Open</td>
</tr>
<tr>
<td>B0015</td>
<td>PM</td>
<td>Exceeding the estimated budget for the project.</td>
<td>We have conducted detailed project planning and cost reporting based on our prior experience in delivering LCNF projects.</td>
<td>The project has delivered all milestones well within the project budget.</td>
<td>Closed</td>
</tr>
</tbody>
</table>
9 Consistency with the Full Submission

There have been no changes to the project scope since the full submission.

10 Bank account

This section is provided as a confidential appendix – see Appendix A.
11 Accuracy Assurance Statement

The project implemented a project governance structure as outlined in the Innovation delivery procedure SR 07 005 that effectively and efficiently manages the project and all its products. All information produced and held by the project is reviewed and updated when required to ensure quality and accuracy. This report has gone through an internal project review and a further review within UK Power Networks to ensure the accuracy of information.

We hereby confirm that this report represents a true, complete and accurate statement on the progress of the Kent Active System Management Low Carbon Networks project in its final six-month reporting period.

Signed ...........................................................

Date ...........................................................

Suleman Ali
Director of Safety, Strategy and Support Services
UK Power Networks